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The Case for Renewables

Mention renewable energy and most people immediately think of wind turbines turning gracefully on a hilltop. However, renewable energy encompasses much more than that: hydropower, solar, biomass, tidal, wave as well as off-shore wind are all renewable technologies, so named, as they harness the infinite forces of nature.

This contrasts rather sharply with fossil-fuels. The product of sedimentation processes over millions of years, they will have been consumed in a matter of centuries. While there is uncertainty over remaining reserves, there is little doubt that with increasing demand for oil and gas, supplies will be limited to a few decades.

Thankfully there are sufficient renewable energy resources to meet our energy needs many times over. In Scotland alone, potential renewable capacity is estimated at 59 GW, far in excess of current electricity demand. The following briefly explores the case for renewable energy.

ENVIRONMENTAL BENEFITS

Electricity from renewables produces no emissions, unlike fossil-fuels which emit a range of pollutants from carbon dioxide (CO_2) to ash (e.g. see table).

Carbon Dioxide
CO_2 is produced when fossil-fuels are burned. It is widely accepted as a major cause of climate change which has will have a range of global and local impacts from agriculture to human health. In responding to this, the UK signed the Kyoto Protocol requiring cuts in CO_2 and other gases by 2010. This is the beginning of a longer process, with the Royal Commission on Environmental Pollution recommending CO_2 cuts of 60% by 2050.

Currently, 28% of UK CO_2 is emitted by power stations. Coal stations produce the most CO_2 per unit of electricity; oil and, particularly gas with its higher efficiency, produce less. 50% of Scotland's electricity comes from aging nuclear stations which emit no CO_2; this proportion will fall as stations retire and, if replaced by fossil-fuels, CO_2 emissions will rise. Achieving Kyoto and longer term targets will rely heavily on growth in renewable energy.

Acid Rain
Fossil-fuelled power stations produce significant quantities of sulphur and nitrogen oxides which are precipitated as acid rain across wide areas. Pictures from the 1980s of dying Scandinavian forests are stark evidence of the effects. Legislation imposed emissions limits and while levels have decreased, this has mainly been as a result of the switch to cleaner gas. A variety of processes can limit emissions but these reduce

station efficiencies and are expensive. Using renewables can avoid these costly removal processes.

Radiation

Radiation is emitted from nuclear and fossil-fuelled (due to trace elements) power stations. The amounts are small with public exposure similar to that of background radiation levels. However, the major environmental issue surrounding nuclear is how to deal with radioactive waste products. Until that issue is resolved and a clear lead given by Government, new nuclear plant will not be built. Once again, renewables can begin to fill the gap.

SECURITY OF SUPPLY

Forecasts of UK energy use suggest high gas dependency. With reserves limited, we will become net importers within a few years. As much of world gas reserves are located in countries that are less than stable undue reliance on such sources is risky. A diversified generating portfolio will tend to promote greater fuel security – another argument in favour of increased renewable energy contribution.

Electricity cannot, at present, be easily (or cheaply) stored and production must continuously be matched to demand. A criticism of renewables is that their intermittent nature prevents guarantees on generating when needed. This is primarily a criticism of wind rather than renewables as a whole and, while intermittency is a concern, analyses have found no significant grid security problems with wind capacities below 20% of the total. Developing a diverse range of renewable technologies, each possessing different temporal characteristics will counteract the intermittency of single sources but ultimately, advances in energy storage will enhance the volume of renewables that may be absorbed.

ENERGY COSTS

Electricity technologies are often selected because they are the cheapest, i.e. the lowest cost per unit (e.g. pence/kWh). Ballpark figures for gas are 2p/kWh, wind at 2.5 to 4.5p/kWh and less mature technologies higher (although costs will fall with development). In the main, renewables appear to more expensive than fossil-fuels and this has led to claims that they will raise electricity prices. There are several reasons why this might not be the case.

Current electricity prices do not reflect the environmental cost associated with production. As such fossil-derived electricity is significantly under-priced, especially in carbon terms. While the European Emissions Trading Directive will start to address this, it will take further steps to level the playing field.

Such ‘levelised’ costs comparisons are derived by applying uniform discount rates to all technologies. Discount rate should reflect the risk inherent in the technology; with this approach there is no differentiation between the risk associated with renewables’ fixed debt and that arising from volatile fossil-fuel prices. When risk is accounted for, the cost differential is reduced or even reversed. Extending this using portfolio theory implies that rather than raising the cost of electricity, renewables diversify the risk and should actually lower prices!

THE FUTURE

In the future, nuclear fusion may well meet our energy needs. Until then, we must grasp the environmental, security and cost benefits offered by renewable energy and make them an essential component of our energy mix.

Pollutant	Coal	Oil	Combined-Cycle Gas Turbine
Carbon dioxide	11,000	9,000	6,000
Sulphur dioxide	150	170	~0
Nitrogen oxides	45	32	10
Particulates	7	3	~0
Solids	840	~0	~0

Emissions from typical 2000 MW power stations, kilotonnes/year (adapted from: Thorogood, K.S.V, 'Electrical power engineering systems: an assessment of their impact on global climate change', IEE Engineering Science and Education Journal, June 1998, pp. 113-121)